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Benthic responses to groundwater–surface water exchange in 2 alluvial rivers in northwestern Montana

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Abstract. We tested the hypotheses that groundwater–surface water exchange regimes affect spatial distribution of algal biomass and Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa in main-channel riffle habitats of 2 northwestern Montana rivers flowing through alluvial flood plains. We used a stratified random design to sample riffles with contrasting groundwater–surface water exchange regimes, but with similar bedform, current velocity, and substrata grain size. We examined general patterns of exchange between river channel and hyporheic zone waters by measuring vertical hydraulic gradients (VHG) and hydraulic conductivities using mini-piezometers. Riffles near the upstream limit of each flood plain were characterized by strong, hyporheic recharge (−VHG, downwelling), whereas riffles throughout the lower half of each flood plain were characterized by weak, dispersed hyporheic discharge (+VHG, upwelling). There were no differences in mean seston concentrations between riffles on either flood plain within any season. Although mean algal biomass was not significantly different across seasons, maximum biomass was generally higher in upwelling zone riffles (+VHG) than in downwelling zone riffles (−VHG). Variation in algal standing crop in upwelling riffles was ~30% greater than in downwelling riffles. There was no difference in mean EPT density between upwelling and downwelling sites. However, there were species-specific responses to differential hyporheic exchange, which were correlated with differences in algal biomass and VHG. The results of our study suggest that hyporheic exchange patterns influence physical habitat structure of main-channel riffles, and affect the distribution and abundance of algae and EPT macroinvertebrates in these habitats.

Key words: groundwater–surface water exchange, hyporheic zone, periphyton, EPT, benthic macroinvertebrates.
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